



Endodontic retreatment: significance and a systematic review of the major protocols

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Abstract

Introduction: In the endodontic treatment scenario, despite the emergence of techniques and instruments that facilitate the treatment, there are still cases that require retreatment of the treated root canals. Non-surgical endodontic retreatment (NSER) can be performed in one or several visits. Endodontic pain has been the main reason for patient consultations after therapy and affects patient comfort. A condition for successful endodontic retreatment is proper cleaning of the root canals, therefore, special attention must be given to the technique used to remove the filling material, with the most commonly used cement, pastes, and gutta-percha cones. **Objective:** This systematic review aimed to evaluate the main protocols and techniques for endodontic retreatment. **Methods:** The present study was followed by a systematic literature review model. Clinical studies were included as case reports, retrospective, prospective and randomized trials with qualitative and/or quantitative analysis. The quality of the studies was based on the GRADE instrument. The risk of bias was analyzed according to the Cochrane instrument. **Results and Conclusion:** The results showed that cleaning and the presence of debris at a speed of 1500 rpm provided greater agility with a smaller number of fractured instruments. Furthermore, the dynamic navigation system enabled the minimally invasive removal of the fiber post with a high degree of precision, without unnecessary removal of the root structure. One visit NSER had lower postoperative pain than multiple visits only for 1 and 30 days. Ultrasonic tips should be considered a good option for endodontic retreatment, especially for cases of

bioceramics. Finally, there is a predominance of *E. faecalis* and *P. gingivalis* in all phases of endodontic retreatment.

Keywords: Endodontic Retreatment. Endodontic treatments. Predictors. Techniques.

Introduction

In the endodontic treatment scenario, despite the emergence of techniques and instruments that facilitate the treatment, there are still cases that require retreatment of the treated root canals [1]. Non-surgical endodontic retreatment (NSER) can be performed in one or several visits [2,3]. Multiple visits are indicated when root canals present acute apical periodontitis symptoms, endodontic lesions refractory by persistent secondary infections [4].

Also, endodontic pain has been the main reason for patient consultations after therapy and affects patient comfort. Generally, the prevalence of postoperative pain varies from 3 to 58% of patients after endodontic retreatment [5]. It may be associated with inflammation in the periradicular tissues and it is believed that the most important reason for endodontic therapy failure is the microorganisms in the apical third of the root canal that survive after endodontic procedures [6]. The elimination of these microorganisms is essential for successful treatment and reducing postoperative pain, especially in retracted infected root canals [7].

In this context, recent reviews have evaluated the influence of a visit session compared to several sessions on postoperative pain to endodontic treatment [8,9].

However, there are no studies that have comparatively evaluated postoperative pain resulting from retreatment endodontics in one visit or several clinic visits. Also, there is no consensus on the technique of endodontic retreatment related to a lower occurrence of postoperative pain, in terms of the number of sessions.

As an example of a predictor for endodontic retreatment, endodontic retraction is a procedure performed on a tooth that has received a previous attempt at a definitive treatment that resulted in a condition that requires additional endodontic treatment to obtain a successful outcome [10-12]. The main cause of treatment failure is insufficient cleaning and inadequate filling [13].

In this regard, a condition for successful endodontic retreatment is proper cleaning of the root canals, therefore, special attention must be given to the technique used to remove the filling material, with the most commonly used cement, pastes, and gutta-percha cones [14,15]. In retreatment, we have to reach the actual working length and completely remove the filling material, clean the root canal, and the final filling. Several techniques are described in endodontic retreatment for the removal of gutta-percha, including rotary instruments, manuals, solvents, and their associations [15].

Thus, this systematic review aimed to evaluate the main protocols and techniques for endodontic retreatment.

Methods

Study Design

The present study was followed by a systematic literature review model, according to the PRISMA rules. Access available at: <http://www.prisma-statement.org/>

Data sources and research strategy

Clinical studies were included as case reports, retrospective, prospective and randomized trials with qualitative and/or quantitative analysis. Also, some review studies were included. Initially, the keywords were determined by searching the DeCS tool and later verified and validated by the MeSH system (Medical Subject Headings, the US National Library of Medicine) to achieve consistent search.

MeSH Terms

The main MeSH Terms were *Endodontic Retreatment*. *Endodontic treatments*. *Predictors*. *Techniques*. The literature search was conducted through online databases PubMed, Google Scholar, Ovid, Scopus, Web of Science and Cochrane Library.

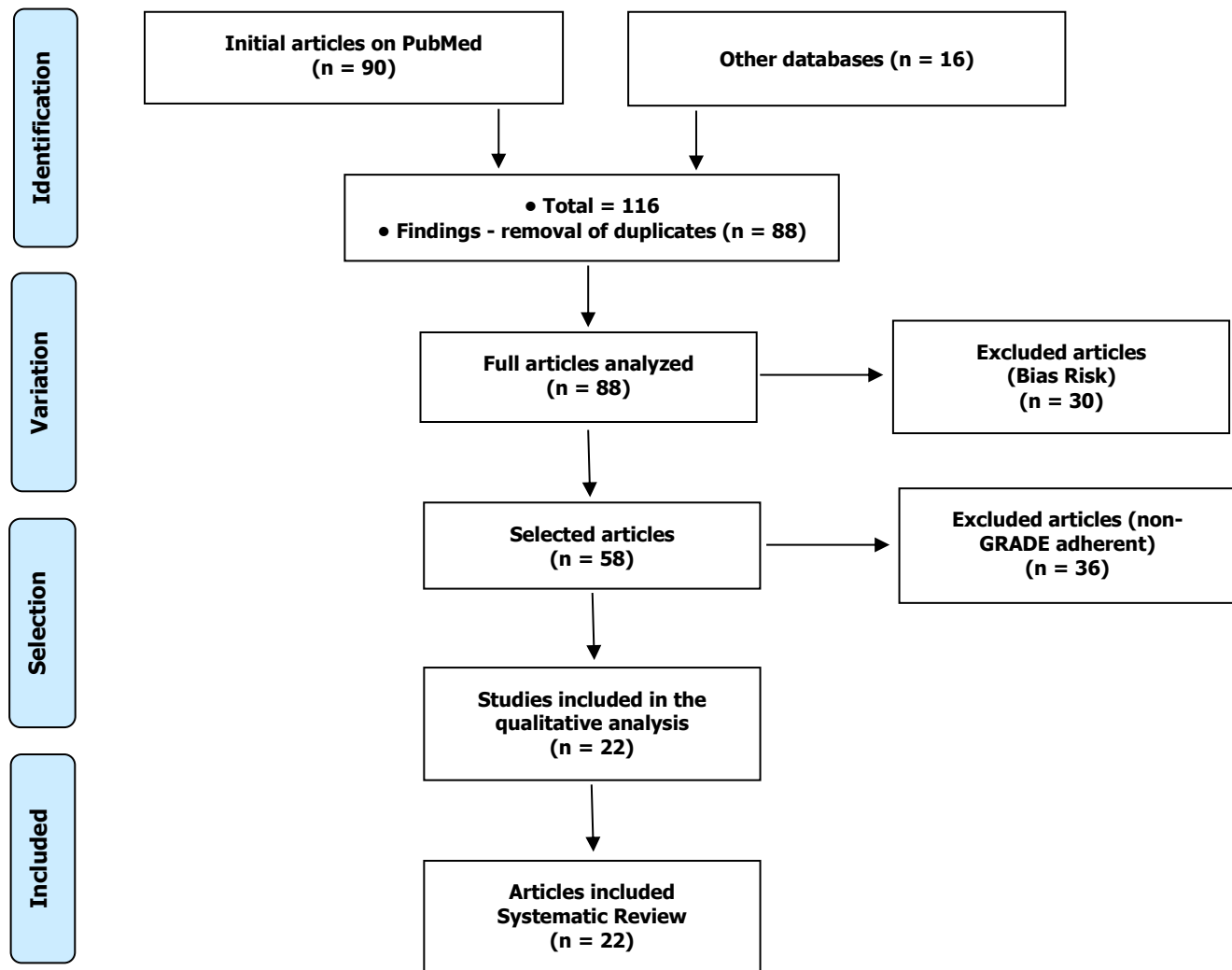
Study quality and risk of bias

The quality of the studies was based on the GRADE instrument, with randomized controlled clinical studies, prospective controlled clinical studies, and studies of systematic review and meta-analysis listed as the studies with the greatest scientific evidence. The risk of bias was analyzed according to the Cochrane instrument.

Review results and discussion

A total of 116 articles were found about Endodontic Retreatment. Initially, was held the exclusion of existing title and duplications following the interest described in this work. After this process, the summaries were evaluated and a new exclusion was held. A total of 58 articles were evaluated in full, and 22 were included and discussed in this study (**Figure 1**). Considering the Cochrane tool for risk of bias, the overall assessment did not result in significant risks that could compromise the science of the present study. According to the GRADE classification, the studies were of moderate quality.

With the analysis of the results of the selected articles, it was found that the authors evaluated the Quantec system for the removal of gutta-percha. In the experiment, the authors used 30 instrumented and filled central incisors, divided into 3 random groups of 10 each. Gutta-percha removal was performed with the Quantec rotary system and 16:1 contra-angle reduction and electric motor, varying the speed in each group: group 1 with 350 rpm, group 2, 700 rpm, and group 3 - 1500 rpm, evaluating the time needed to reach the work duration, the gutta-percha removal time, the total time, the apical extrusion of the material during removal and the number of fractures of the instruments. After removing the material, the teeth were radiographed and the root canal wall was cleaned. Afterward, the teeth were striated longitudinally, sectioned and the cleaning of the root canal walls evaluated visually scanned with a scanner and with the measured residues. They observed that the 1500 rpm group was significantly faster than the other groups and that the amount of material extruded apically was not significantly different between the groups. In cleaning the middle third, it is possible to notice a radiographically large difference between the 14 groups, in this, the group with 350 rpm presented the greatest amount of debris. Group 1 resulted in 6 fractured instruments. In group 2, four fractured instruments, and group 3 only one fractured instrument. They concluded that cleaning and the presence of debris were equivalents between groups, but the use of 1500 rpm provided greater agility with fewer fractured instruments [16].

Figure 1. The selection process of scientific articles.

Also, a case report demonstrated the use of dynamic navigation to remove a post under a zirconia crown for the retreatment of a failed root canal procedure. Removing fiber posts from endodontically treated teeth can present a unique challenge for dentists. Numerous techniques and instrument kits are recommended for removing fiber posts, but the risk of excessive damage to the root structure is a major concern as the ability to differentiate the color difference between peripheral dentin and a bonded fiber post can complicate the accuracy of removal. Therefore, the dynamic navigation system enabled the minimally invasive removal of the fiber post with a high degree of precision, without unnecessary removal of the root structure [17].

Besides, the authors tested the efficiency of gutta-percha removal using the ProFile system. They selected 48 human teeth with root canals with curvature between 25 and 45, instrumented by the standardized method with Do=30 and 0.04 taper, and filled with vertical condensation of gutta-percha. They compared the obturation material removal between the techniques

with flexible K files with chloroform; Type H file with chloroform; ProFile .04 with chloroform and ProFile .04. They measured the time to perform the technique and the presence of remaining debris. The roots were divided into apical, middle, and cervical thirds and measured on a scale from 0 (no debris) to 3 (>50.0% walls with debris) and observed radiographically. The results of the presence of remnant debris in root canals instrumented with K+ lime chloroform; ProFile + chloroform was lower and did not differ significantly between the three root levels examined; While Hedeströen and ProFile + chloroform did not show significantly different results in the apical portion. In general, cervical cleaning was superior when compared to the apical third. The results indicated that the ProFile system and the manual files + chloroform present similar cleaning, but that with ProFile there were 15 greater time savings in performing the deobturation when compared to manual files [18].

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In addition, a case report demonstrated the use of dynamic navigation to remove a post under a zirconia crown for the retreatment of a failed root canal procedure. Removing fiber posts from endodontically treated teeth can present a unique challenge for dentists. Numerous techniques and instrument kits are recommended for removing fiber posts, but the risk of excessive damage to the root structure is a major concern as the ability to differentiate the color difference between peripheral dentin and a bonded fiber post can complicate the accuracy of removal. Therefore, the dynamic navigation system enabled the minimally invasive removal of the fiber post with a high degree of precision, without unnecessary removal of the root structure [17].

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Besides, a systematic review and meta-analysis study assessed postoperative pain (PP) after non-surgical endodontic retreatment (NSER) at one visit compared with multiple visits. The PICO question used was "Does the NSER in patients with unsatisfactory endodontic treatment in one visit visit have a postoperative pain similar to that of the NSER in multiple visits?" The NSER of one visit had lower postoperative pain than multiple visits only for 1 and 30 days [(RR = 0.67; CI: 0.48 to 0.93; p = 0.02), and (RR = 0.09; CI: 0.01 to 0.66; p = 0.02)], respectively. Regarding the sub-analysis regarding intensity, one visit had a lower mild POSTOPERATIVE PAIN when compared to multiple visits [(RR = 0.54; CI: 0.30; 0.96; p = 0.04); (RR = 0.33; CI: 0.12, 0.88; p=0.03); and (RR=0.12; CI: 0.02, 0.86; p=0.03)], respectively. However, the subanalysis for moderate and severe postoperative pain showed no significant difference, regardless of the period evaluated (p> 0.05). Both endodontic retreatment therapies can be considered in clinical practice [19].

In addition, a study evaluated the effectiveness of supplementary techniques (ultrasonic tip / XP-endo Finisher R) in removing remaining filling materials (gutta-percha / AHPlus / BCSealer) from oval root canals during non-surgical retreatment endodontics. roots. Lower values of remaining filling material were found for BC Sealer (16.06 ± 14.34) compared to AH Plus (28.30 ± 10.54) (p <0.001), and considering the complementary technique, lower values of remaining filler material were found for the ultrasonic tip (18.95±11.05) compared to XP-endo Finisher R (25.41±15.81) (p=0.025). The ultrasonic instruments significantly reduced the percentage of filling material remaining for AH Plus (p=0.04) and BC Sealer (p=0.02), while XP-endo Finisher R was effective only for AHPlus (p=0.04). Therefore, Complementary techniques increased the removal of filling material; however, none

of them were able to make the root canals completely free of root fillings. Ultrasonic tips should be considered a good option for endodontic retreatment, especially for cases of bioceramics [20].

Also, the authors evaluated the effectiveness of gutta-percha removal in curved canals in retreatment using the manual technique, FlexMaster, Protaper and Race observed that the manual and FlexMaster techniques denote larger areas of obturation debris and that the Race system presented better results than Protaper for cleaning capacity, although slower and with lower risk of fractures [21].

Still, other authors have shown that the movement used to activate the instrument is one of the most important factors in determining the resistance to cyclic fatigue. In their study, ProTaper® F2 instruments were used, which were divided into two groups, A and B, group A in reciprocal kinematics and group B in continuous rotation. The instruments presented superior resistance to cyclic fatigue when actuated in reciprocal motion when compared to the same instruments actuated in continuous rotation. In addition, the same authors above performed a quantitative evaluation of the dentin tissue extruded through the apical foramen during instrumentation of the canal system. The work was carried out on extracted teeth. For the control group, they used teeth instrumented manually with Flexofile® type files, which were pre-extended with Gates Glidden type burs. The study was carried out comparing the conventional instrumentation of the ProTaper® system (rotating) and the instrumentation with a single ProTaper® F2 file in reciprocal motion. It was concluded that there is no significant difference in the amount of dental tissue extruded between the two instrumentation methods [14].

Besides, a study to characterize the microbiota of teeth with endodontic treatment failure by genetic sequencing of 16S ribosomal RNA (GS) and PCR in the different phases of endodontic retreatment and associated the presence of specific bacteria with clinical and radiographic characteristics in teeth with apical periodontitis in 20 infected root canals of single-rooted teeth. As a result, a total of 89 strains were identified using GS. Sixty-five strains were recovered in S1 and 15 strains in S2, and 9 strains remained in S3. *Enterococcus faecalis* was the most prevalent bacterium. Gram-positive cocci bacteria predominated. Gram-negative species were also detected. Using species-specific PCR primers to detect seven species, the most prevalent in all stages of endodontic retreatment were *E. faecalis* and *Porphyromonas gingivalis*. However, *Parvimonas micra* and *P. gingivalis* were associated with prior pain, *P. gingivalis* was associated with percussion sensitivity,

and *E. faecalis*, *Fusobacterium nucleatum*, and *P. gingivalis* were associated with periapical lesion > 3 mm. Therefore, there was a predominance of *E. faecalis* and *P. gingivalis* in all stages of endodontic retreatment [22].

Conclusion

The results showed that cleaning and the presence of debris at a speed of 1500 rpm provided greater agility with a smaller number of fractured instruments. Furthermore, the dynamic navigation system enabled the minimally invasive removal of the fiber post with a high degree of precision, without unnecessary removal of the root structure. One visit NSER had lower postoperative pain than multiple visits only for 1 and 30 days. Ultrasonic tips should be considered a good option for endodontic retreatment, especially for cases of bioceramics. Finally, there is a predominance of *E. faecalis* and *P. gingivalis* in all phases of endodontic retreatment.

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Data sharing statement

No additional data are available.

Conflict of interest

The authors declare no conflict of interest.

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